

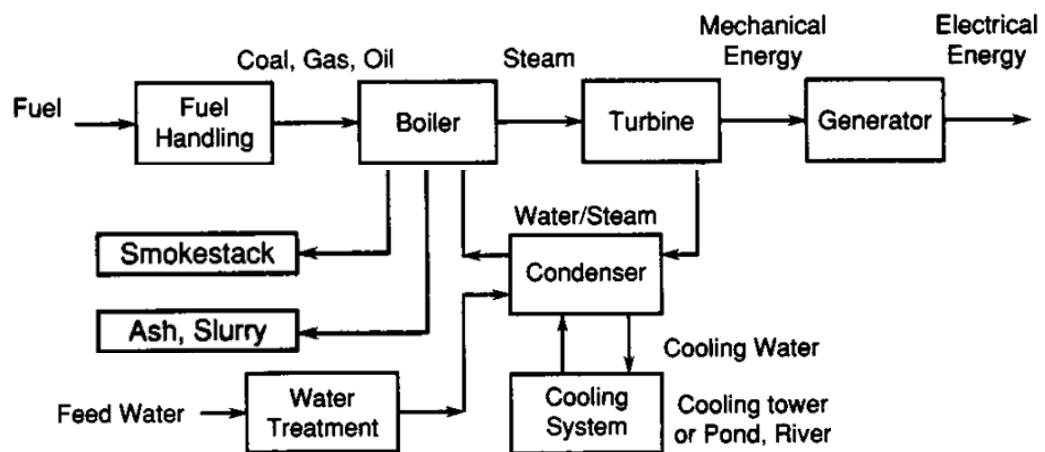
# Chapter 2

- Generation of Electricity only means: conversion of any other energy to electrical energy. Such as
  - Heat (thermal energy) → electricity
  - Light energy → electricity
  - Potential energy → electricity
  - Kinetic energy → electricity
- The sources of energy which have been in use for a long time are termed as Conventional.
- Conventional energy sources used by power plants include,
  - fossil fuel (Gas, Oil, and Coal),
  - Biomass (Wood, Peat)
  - nuclear fuel (Uranium)
  - hydro energy (Water falling from height)
- Most of the electrical energy, all over the world, is generated by conventional power plants.
- The resources which are yet in the process of development over the past few years are termed as Non-Conventional.
- Non-Conventional energy sources used by power plants include,
  - Solar (photovoltaic, thermal),
  - Wind,
  - Geothermal,
  - Wave,
  - Tidal,
  - Ocean Thermal,
  - Biofuels (Biogas etc.),
  - Fuel cells

Basis	Non-Conventional energy.	Conventional energy.
1. Example	Wind, Solar, Biomass, Biogas, Tidal, Wave, etc.	Coal, Oil, Natural gas, Nuclear energy, etc.
2. Source	Natural local environment	Concentrated stock.
3. Normal State	A current of energy and income	Static store of energy capital.
4. Life time supply	Infinite	Finite
5. Cost at source	Free	Increasingly expensive
6. Variation in supply	Fluctuating	Steady
7. Supply cost	Low	High
8. Scale	Small	Large
9. Safety	Mild Local hazards possible in operation	Most dangerous when faulty
10. Pollution	Little environmental impact confining the region	Massive environmental pollution : air water, soil, common and wider speed
11. Context	Rural , decentralized system	Urban, Concentrated system

- In Oman, electricity is generated at **thermal power plants** using **Natural Gas**.
- There are such **8 power plants** located in the north portion of Oman which are part of **Main Interconnected System (MIS)**
- Some of these power plant are **Open Cycle Power Plants** where as some are **Combined Cycle Power Plants**.
- The **new** power plants are **Combined Cycle Power Plants**.

## Open Cycle (OCPP)



A generating station which converts heat energy of coal combustion into electrical energy is known as a steam power plant.

1. A thermal power station basically works on the principle of Rankine cycle.
2. Steam is produced in the boiler by using the heat of coal combustion.
3. The steam is then expanded in the prime mover (i.e.: Steam turbine) and is condensed in a condenser to be fed into the boiler again.
4. The steam turbine drives the alternator which converts mechanical energy of the turbine into electrical energy.
5. This type of power station is suitable where coal and water are available in abundance and a large amount of electric power is to be generated.

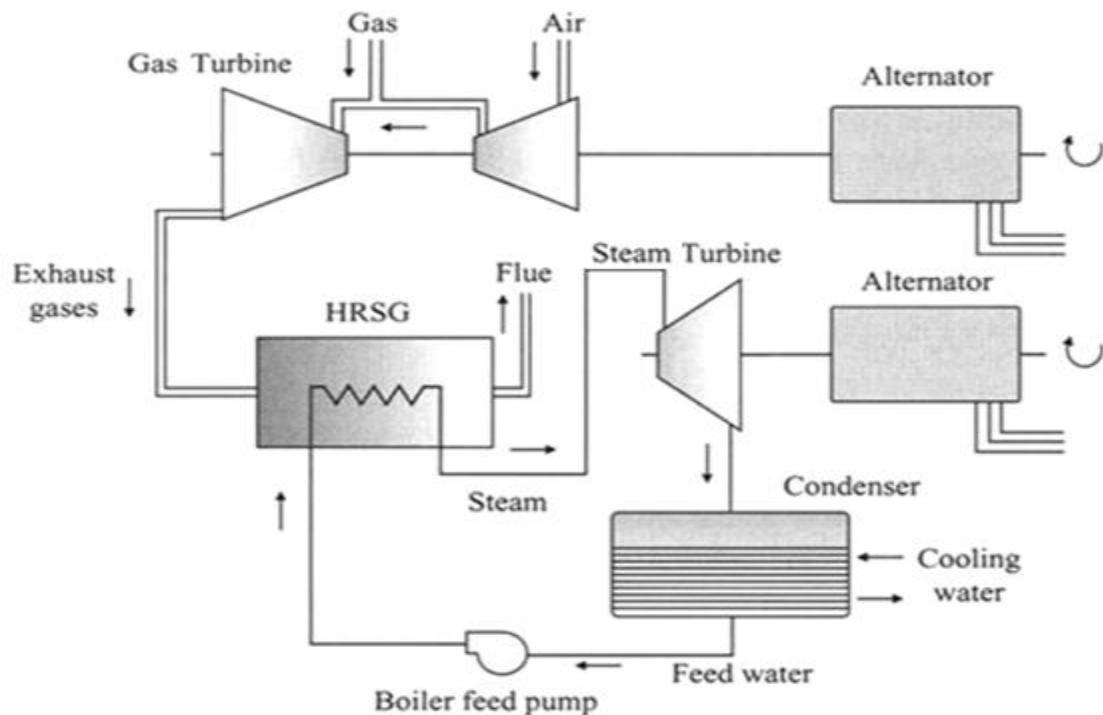
### Advantages:

1. The fuel (coal) used is quite cheap
2. Less initial cost as compared to other generating stations.
3. It can be installed at any place irrespective of the existence of coal. The coal can be transported to the site of the plant by rail or road.
4. It requires less space as compared to the hydro power station.
5. The cost of generation is less than that of the diesel power station.

### Dis advantages:

1. It pollutes the atmosphere due to the production of large amount of smoke and fumes.
2. It is costlier in running cost as compared to hydroelectric plant.

## Combined Cycle Gas Plant (CCGP)



A combined-cycle power plant uses both a gas and a steam turbine together to produce up to **50 %** more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power.

### Gas turbine burns fuel

- The gas turbine compresses air and mixes it with fuel that is heated to a very high temperature. The hot air-fuel mixture moves through the gas turbine blades, making them spin.
- The fast-spinning turbine drives a generator that converts a portion of the spinning energy into electricity.

### Heat recovery system captures exhaust.

- A Heat Recovery Steam Generator (HRSG) captures exhaust heat from the gas turbine that would otherwise escape through the exhaust stack.
- The HRSG creates steam from the gas turbine exhaust heat and delivers it to the steam turbine.

### Steam turbine delivers additional electricity.

- The steam turbine sends its energy to the generator drive shaft, where it is converted into additional electricity.

### **Advantages of Natural Gas:**

1. **Less Harmful than Coal or Oil:** As compared to petroleum or coal, natural gas causes less damage to the environment.
2. **Neater:** Gas appliances do not create electric fields which are unhealthy near your homes.
3. **Industrial use:** Natural gas is used for producing hydrogen, ammonia for fertilizers and some paints and plastics.
4. **Vehicle Fuel:** Natural gas can be used as a fuel for vehicles (cars, trucks, jet engines). It is a cleaner, cheaper fuel than diesel or gasoline.
5. **Burns Cleaner:** Natural gas burns cleaner without leaving any smell, ash or smoke.

### **Disadvantages of Natural Gas:**

1. **Toxic and Flammable:** Leaks of natural gas are tremendously dangerous. Such leaks may cause explosions or fire.
2. **Damage to Environment:** Burning of natural gas also releases carbon dioxide, carbon monoxide and other carbon compounds which are greenhouse gases that cause [global warming](#) and [climate change](#).
3. **Complex Processing:** For use as fuel, except for methane, all other constituents of natural gas have to be extracted. Processing results in many byproducts: hydrocarbons (propane, ethane etc.), sulfur, water, helium, nitrogen, and carbon dioxide.
4. **Non-Renewable:** Like all [fossil fuels](#), natural gas though found in abundance is non-renewable and hence likely to be exhausted at some point of time. It is not a long term solution to our energy problems.

### **Nuclear Power Plant**

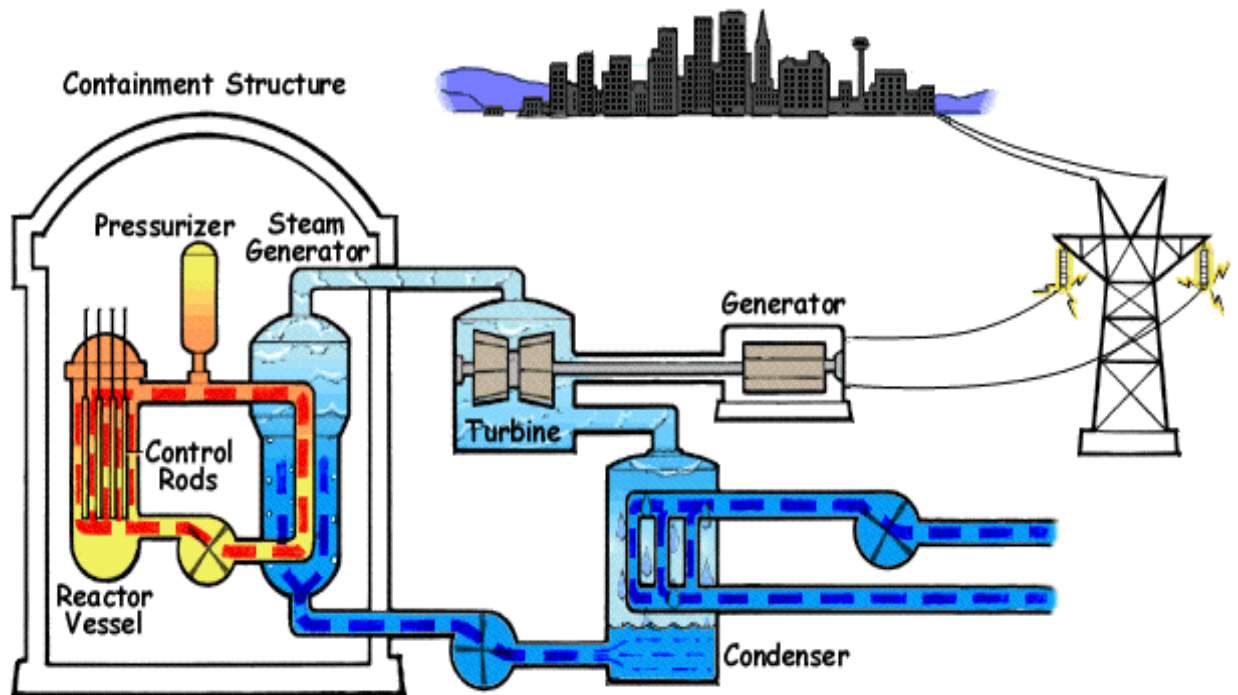
A generating station in which nuclear energy is converted into electrical energy is known as a nuclear power station.

In nuclear power station, heavy elements such as Uranium (U235) , Thorium ,(Th232) are subjected to nuclear fission in a special apparatus known as reactor.

The heat energy thus released is used in raising steam at high temperature and pressure

The steam runs the steam turbine which converts steam energy into mechanical energy.

The turbine drives the alternator which converts mechanical energy into electrical energy.



#### Advantages:

1. The amount of fuel required is quite small. Therefore, there is a considerable saving in the cost of fuel transportation.
2. A nuclear power plant requires less space as compared to any other type of the same size.
3. It has low running charges as a small amount of fuel is used for producing bulk electrical energy.
4. This type of plant is very economical for producing bulk electrical power.

#### Dis advantages:

1. The fuel is used is expensive is difficult to recover.
2. The capital cost on a nuclear plant is very high as compared to other types of plants.
3. The erection and commissioning of the plant requires greater technical persons.
4. The fission by products is generally radioactive and may cause a dangerous amount of radioactive pollution.